Report of the
Select Committee on Forestry

WOODCHIP and BIOMASS

House of Assembly
Nova Scotia
May 1987

Select Committee
on Forestry

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Hon. Arthur R. Donahoe, Q.C.
Speaker of the House of Assembly
12th Floor, Toronto Dominion
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1791 Barrington Street
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Dear Mr. Speaker:

I am writing in my capacity as Chairman of the Select Committee on Forestry to inform you that the Committee has completed its inquiry in Wood Waste, Wood Residue and Biomass as it relates to a source of energy in Nova Scotia.

In accordance with Resolution No. 465 passed by the House of Assembly on May 2, 1985, I am pleased to submit to you the Report of the Select Committee on Forestry.

Yours truly,

Jack Coupar, M.L.A.
Chairman

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INTRODUCTION

Nova Scotia, for reasons of geography, has for the last fifteen years been in a sensitive position with respect to energy supply. Since the energy (oil) crisis of 1973, the price of petroleum increased steadily until early 1986, with supply security a major question in the minds of many Nova Scotians. During this period, the Province has embarked on programs to conserve energy and to use indigenous coal reserves for the generation of electricity.

These programs have been successful in reducing the growth in energy use and in adding stability and security to our energy supply situation.

Today, energy use in Nova Scotia has changed substantially from the mid-1970's. The portion of our energy requirements for light and heat served by petroleum has fallen from 76% in 1979 to 64% in 1984, with indigenous coal responsible for the bulk of this oil displacement. When we compare this to the Canadian average however, we find that petroleum provides only 33% of energy for light and heat in the rest of the country. Natural gas, greater available hydro potential, and the use of nuclear energy reduces the dependence of most areas of Canada on petroleum energy.

End use energy used by sector in Nova Scotia in 1984 may be broken down as follows:

(a)	Transportation	78.6 trillion Btu's	33.3%
(b)	Industrial Use	60.1 trillion Btu's	25.5%
(c)	Residential Use	57.8 trillion Btu's	24.5%
(d)	Commercial Use	39.3 trillion Btu's	16.7%

Of particular interest is the 99.4 trillion Btu's used in the industrial and commercial sectors because these are the areas of greatest opportunity for the development of a wood fueled energy supply option.

The use of wood for energy will not only help to enhance Nova Scotia's energy security through the use of an indigenous energy resource, but Nova Scotia will also benefit substantially from improved forest management practice. The improved productivity of our forest resource will add a much needed economic stimulus to the largest resource based industry in the Province.

For these reasons, the Government of Nova Scotia established the Select Committee on Forestry. This committee came into being as a result of a Resolution presented in May 1985, by the Minister of Lands and Forests, the Honourable Ken Streatch.

The resolution took note of the contribution to the provincial economy of the extensive industrial harvest from our provincial forests. Forest sector products include pulp, paper, hardboard, lumber, Christmas trees, manufactured wood products such as furniture or building components and other wood products including wood used for fuel. During the term of the Committee, the Government of Nova Scotia announced its new Forest Policy. This policy and its subsequent enabling legislation has highlighted the Government's desire to expand forest management with the goal of doubling the industrial harvest from our forests. This will require the promotion and development of new products, higher value added output, and new and larger markets.

The resolution also stated that consistent with the provincial government's forest management policies and programs, there would be continuing opportunity for greater use of forest residue and wood waste to supply energy to industrial, institutional, and educational facilities.

Under the terms of the resolution, the Committee was authorized and directed to enquire into the use of wood chips, wood residues, and other forest biomass as a source of energy for domestic, institutional, commercial, agricultural, and industrial energy users throughout the province. Without restricting the generality of the terms of enquiry, the Committee was also directed to consider all appropriate aspects of wood fibre combustion. Specifically the Committee investigated the following issues:

1) Availability of an ongoing supply of wood chips, residue, and other forest biomass

2) Transportation systems for wood chip products

3) Marketing groups, individual contractors, bulk contractors, free-market supply, delivery and price

4) The advantages of greater use of energy derived from forest biomass to the consumer, to the forestry industry and to the general economy of the Province of Nova Scotia

5) Enhancement of silviculture programs and development of the New Forest concept through woodland improvements and biomass harvesting consistent with advanced management practices

6) Methods, efficiency, and costs of harvesting and producing wood chips, wood residue and other forest biomass

7) The environmental consequences (forest soil nutrients) of harvesting and preparation of biomass products for markets.

Membership of the Select Committee on Forestry.
(Wood Chips)

Chairman, Jack Coupar, M.L.A., Colchester North

The Hon. Ken Streatch, Minister of Lands and Forests.
The Hon. Joel Matheson, Minister of Mines and Energy.
Cora Etter, M.L.A., Hants East.
Dr. Jim MacLean, M.L.A., Inverness North.
Donald MacLeod, M.L.A., Cape Breton West.
Harold Huskilson, M.L.A., Shelburne.
Guy Brown, M.L.A., Cumberland Center.
Bob Levy, M.L.A., Kings South.

Staff:
Douglas MacLeod
(Principal Assistant to the Minister of Lands and Forests.)
W. D. Fraser, Secretary.

Committee Investigations

General

In order to inquire into and investigate fully the issues contained in the resolution which established the Committee, public hearings were held to receive submissions from private industry, government agencies and interested trade associations. The Committee also visited existing wood fueled sites in Nova Scotia, Prince Edward Island, Maine, and in Sweden.

Submissions were received as either written briefs or oral presentations with questions solicited from committee members. This process gave the Committee the opportunity to hear the opinions of the Nova Scotian forest sector companies, individual woodlot owners, and general forestry operators, as well as potential wood fuel customers, i.e. industry, institutions, and municipalities.

In addition to review and discussion of the various submissions as well as in questions to the presenters at public hearings, Committee members made use of opportunities to obtain additional information and opinions from other sources.

On Committee visits to Maine, Prince Edward Island and in Sweden, members viewed and discussed a number of aspects of wood fibre production, marketing, and plant installation as well as the types of market served.

Almost without exception, the Committee found that wood fibre used for energy was considered **to be a significant means of oil import substitution, job creation, and the basis of sound and increasingly more productive forest management.**

Presentations

After appropriate advertisement, public hearings were held at Port Hawkesbury, Truro, and Halifax. The following lists the presentations heard by the Committee at the various public hearings:

Wood Product Manufacturers Association of Nova Scotia
Walter Thompson
Royce Hefler

Atlantic Transfer Heat Limited, Bedford, Nova Scotia
Michael Kerman
Claude Desrochers

Black River Hydro Company
Neal Livingston

N.S. Landowners & Forest Fibre Producers Association
Brian Arseneau
Edward Chirico

Nova Scotia Forest Products Association
Lorne Etter
Duncan MacAdams
Doug Bragg
Dennis Barnhill
Dave Barrett

Nova Scotia Woodlot Owners and Operators Association
Ronald Bulmer
Brian Levy

North Colchester Forest Co-op Limited
Dale Downey

The Government of Nova Scotia
Department of Mines and Energy

The Government of Nova Scotia
Department of Lands and Forests

Nova Scotia Research Foundation
Dr. Don MacAulay

Stora
Dr. Ake Thor

Private Submission
Fred Buckly, P.Eng.

Site Visits

In order to obtain first hand information on the use of wood fuel in other jurisdictions, the Select Committee visited sites in Prince Edward Island, the

State of Maine and Sweden. The findings and impressions of Committee Members as a result of these visits are recorded in this Section.

In Prince Edward Island, Committee members visited:

Kings County Memorial Hospital wood chip heating system.

Senior Citizens facility — wood chip heating system built as part of the facility's construction.

Charlottetown District Heating System — a district heating system heated by a wood chip boiler.

The Tricil operation utilizing garbage combustion.

Prince Edward Island has traditionally burned sawmill residue for heat in forest related facilities and is now using wood fibre as fuel for heating plants that provide steam and hot water for hospitals, schools, and other public buildings. Wood chips are also occasionally used to supplement refuse at the Charlottetown energy from waste plant.

PEI's growing interest in wood fuel combustion complements provincial government policies of forest improvement. They want to replace poor growth and undesirable species with trees of better quality. The replacement programs will augment and stabilize the availability of wood fuel product as well as conventional forest products.

The Government of Prince Edward Island is committed to wood fibre use and designers of new public buildings are required to investigate the combustion of forest residue for heating. The district heating plant at the Prince Edward Home for the Aged which heats several buildings using low pressure hot water is the first of its type in Atlantic Canada.

Provincial authorities regard wood fuel combustion as a means of import substitution through substantial reduction of oil purchases.

While the Committee did not visit any sites in the Province of New Brunswick, written information was solicited on the use of wood fuel in that province. New Brunswick has been successful in replacing significant amounts of imported oil with wood fuel within the forest industry and in business, institutions, and households. They have investigated the development of improved harvesting techniques and the assembly of supply systems. New Brunswick has also been active in wood fuel technology, particularly in the development and testing of systems and the distribution of information. Because of the major economic importance of forestry in New Brunswick, there has been strong government interest and support in these developments.

New Brunswick's Department of Natural Resources and Energy is responsible for the forests and also for energy and resource management. This Department has developed conservation and alternative energy programs, including the development of biomass fuel program initiatives which they plan to fund under their recently signed Memorandum of Understanding with the Government of Canada. Their programs have resulted in about thirteen institutional installations with at least an equivalent number in the planning or construction stage.

In Maine, members visited three industrial facilities using wood fibre fuel, as well as viewing cutters, chippers and transport vehicles operating in the forest. Members also observed forest management procedures. Sites visited:

S.D. Warren, pulp & paper mill, which has a staff of 2,000 as well as part of their forest operation.

A smaller mill with sawing operations and using sawdust, slash, chips and residue to produce heat and co-generate off-peak electricity for the Central Main Power grid.

Bates Fabric, a textile mill in Dover/Foxcroft modified to burn wood chips for heat and to co-generate electricity for delivery to the CMP grid.

Maine has developed the use of wood as an indigenous and renewable source of energy. This was accelerated by the oil crisis which resulted in a substantial increase in energy costs. At the time Maine, a state without coal resources, was 80% dependent on foreign oil. This dependency has now been reduced to less than 60%.

Ninety percent of Maine is forest land and wood chips have been found effective and cost competitive as fuel for the co-generation of steam and electricity. The changeover began with firms with access to waste wood such as pulp and paper companies and sawmills. Usage has since expanded to factories, schools, greenhouses, and for district heating at a university and a military base.

Maine has concentrated on the use of wood chips to supply part of their electrical generating needs through co-generation because Maine lacks coal reserves and has a number of energy intensive industries. Under the Public Utilities Regulatory Policies Act passed by the United States Congress, principal utilities are required to buy power from private producers and co-generators at full avoided marginal cost. Further encouragement was given through the Economic Recovery Tax Act and write-off benefits of up to 60%

which attracted capital at lower net cost for energy projects that were marginal under normal conditions.

Whole tree chipping of trees of unmerchantable quality was encouraged. The use of roundwood for residential use was also expanded. This provided incentive for forest management by private owners at no cost to the state.

The committee visited woodland operations and observed a variety of methods of harvesting and equipment combinations in operation. These included small mobile feller bunchers, roadside chippers and specialized chip vans. At other sites, members observed professional foresters marking the trees to be left after cutting. Unmarked trees were culled and underbrush cleared to improve growing conditions for the remaining good quality trees.

The committee also visited a sawmill and a textile mill with a partially constructed co-generation installation at Dover-Foxcroft.

An extensive tour was made of the S.D. Warren pulp and paper operation (a division of Scott Paper), where a co-generation plant has been operating since 1982. It uses more than fifteen hundred green tonnes of wood fuel per day and can generate 47,000 kw of electrical power.

The S.D. Warren complex buys wood chips from more than twenty whole-tree chipping operators. Fuel is delivered in 45-foot highway trailers which are unloaded into fuel bins using hydraulic tipping platforms. Screens remove large pieces of wood and foreign material. The material is then fed by conveyor to the boiler plant.

Estimates of Maine's forest lands show enough available biomass to support more than twenty projects of the size of the S.D. Warren installation, or roughly the equivalent of 1,000 megawatts of electrical energy. That optimum figure would be subject to transportation costs and location of generating plants within economic distance of supply areas.

The most extensive tour undertaken by the Committee was to Sweden where visits were made at the following industrial and woodland locations:

Falun	Sandvik
Borlange	Kvarnsueden
Vaxjo	Norsundet

Stops were made enroute at other locations to visit forest sites, storage, and small unit installation as well as large district heating plants. Discussions were also held with business and technical experts in Stockholm.

Appreciation has been expressed to the Swedish companies, STORA, Sodra Skogsagarna, AG Energikonsult, and to Lars Ojefors of NYDO for his

detailed exposition of Swedish experience in building up markets for wood chips.

Without exception, company managers and staff and Swedish government officials were most helpful and courteous and expressed interest in forest activities in Nova Scotia.

Sweden does not have domestic supplies of coal, oil, or natural gas although preliminary investigations are being made of potential gas sources. Sweden does have substantial resources of hydroelectric power, forest biomass, and peat.

Sweden now has more than a dozen nuclear power plants but a recent plebiscite confirmed the public decision to phase out all their nuclear plants by the year 2010. Since the Chernobyl disaster and the consequent contamination of Swedish territory, particularly field crops and reindeer in Lapland, the phase out date has been advanced to 1994.

The impending elimination of nuclear power generation emphasizes the need for other sources of energy and will require that the Swedes more fully exploit their domestic resources. This will also reduce Sweden's vulnerability to any future crisis in world oil prices.

Fifty percent of Sweden's current electrical supply comes from their nuclear installations. Hydro-electric, coal and oil-fired plants account for forty-eight percent of the remainder and the other two percent comes from forest biomass, peat, and garbage combustion.

Sweden's future goal is to increase the amount of electrical energy obtained from biomass and peat to ten percent. Using co-generation technology, oil consumption is to be reduced. They are converting existing oil fired facilities to wood fuel and modernizing hydroelectric plants as well as building new ones where appropriate.

The Swedes estimate that for every 1000 tonnes of green wood chips used to displace oil, one person-year of employment will be created in the wood chip industry. This will reduce unemployment below their current rate of about three percent and reduce seasonal layoffs.

Sweden's electricity costs about four cents Canadian per KWh (average) but there are seasonal variations. The rate structure is flexible and is affected by the source, i.e. hydro-electric is cheaper during high water storage. In low storage periods the load is switched to coal or petroleum plants with consequent higher cost. There are further complications in assessing rates because of frequent demand and distribution interchange between city, community, or regional utilities.

Swedish forests are exceptionally clean and almost free of disease. Because naturally regenerated stands contain too many stems for good growth, they are cleaned at age 15 to 20 years. At age 40, many plantations

and previously cleaned stands are commercially thinned 1 to 3 times before final harvest at age 70 to 120 years. On average the capability of Sweden's forest land to produce fiber is less than Nova Scotia's.

The material weeded out or harvested at the 15 and 40 year levels is used for pulp wood or energy combustion, and is generally not left in the woods to decay. It was pointed out that in about a third of the forests, soil conditions may require some of the biomass to be left for replenishment of nutrients. (Note: most of a tree's nutrients are contained in leaves and needles.) In some locations, tree stumps and root systems are being removed for energy combustion but there are concerns about the long-term effects on the soil from the disturbance of removal.

The committee visited a number of operations of particular interest. In Southern Sweden, the city of Vaxjo's district heating plant has a capacity of 1,000 megawatts of thermal output. It services a population of 50,000 people, with billings of more than fifty million dollars a year. The plant was built in 1975 to burn oil and coal but has been fully converted to wood chips and peat to reduce fuel costs. A chip/peat mixture is ground to a fine powder in a hammer-mill and blown into the boilers. Efficiency is about 90%, which is considered to be very high. This high efficiency is the result of using waste stack heat for drying fuel and pre-heating water returning to the plant from the district heating system.

The Vaxjo plant does co-generate some electricity but its production cost of 9 cents per KWh is about double the national average.

District heating systems have both government and community support throughout Sweden with local meetings held at appropriate times for discussions of plants, problems, costs, and advantages of various proposals. The generation, distribution and intersystem billing of heat and electricity seem complicated to the visitor but appear to work effectively.

Another district heating system was visited at Borlange. It was a 125 MW thermal output facility, 20% fueled by wood chips, 15% by garbage and the balance from heat pumps which took heat from pulp mill effluent, lakes, rivers, and ground water. Heat pumps make a major contribution throughout Sweden, and in Stockholm, about half of the city's heat requirement is from heat pumps that extract a few degrees of heat from the Baltic seawater.

In some of the district heating plants visited, wood-burning boilers were shut down during periods of low load and heat was entirely supplied by heat pumps, in some cases for up to six months of the year. In most plants, the wood-burners would be started at about the end of October. The wood-burning units seen had very clean emissions and appeared to be fully acceptable to a residential neighborhood. There is now concern that the closing of the nuclear generating facilities will cause an increase in the cost of electrical

energy which will have a negative impact on the cost of district heating where heat pumps are being used.

As an example of the cost of producing wood chips for energy, one wood chip district heating system gave the following cost data:

Raw materials or stumpage	15%
Chipping, etc.	50%
Transporting chips	20%
Administration	15%

Sweden now harvests 70 million cubic meters of forest fibre annually compared to 60 million in 1960. The annual growth is greater than the harvest and averages 90 million cubic meters.

Total volume of all merchantable wood in Swedish forests is 2.5 billion cubic meters, fifty percent higher than the volume in 1920.

As an example of the benefit of forest management, it is worth noting that the Swedes imported the lodgepole pine from British Columbia (a species not in strong demand on the Pacific coast). Lodgepole pines were planted and cultivated in Sweden and now grow eighty percent more timber per unit of forest land than Sweden's indigenous species.

Sweden is a unitary state and national forestry policies are developed in consultation between federal agencies and the private sector and when initiated, are carried out as national policy. In contrast, Canadian forestry is a provincial matter with each province determining its own operation and management policies.

As well as visiting sites and investigating wood fuel issues in other jurisdictions, the Committee also visited several sites in Nova Scotia. The sites visited were:

Scott Maritimes Limited
Stora Forest Industries
Williams Lumber Mill
Britex Limited
Avon Valley Greenhouses Limited

Visits to these sites gave the Committee members a sampling of the current wood energy use in Nova Scotia with respect to combustion systems, fuel supply and the types of industrial activity involved in the use of wood energy.

Nova Scotia Situation

Wood has been and continues to be an important source of Nova Scotia's energy, currently about 8 percent of end-use demand. In 1984, residential and industrial wood energy use was equivalent to 1.8 million barrels of oil. At current oil prices (about 25 dollars Canadian per barrel of crude), this represents approximately 45 million dollars, retained in the provincial economy each year.

Residential wood burning continues to be an important component of the total volume of wood burned in the province. Recent surveys conclude that approximately 45 percent of homes in the province use roundwood to supply at least a portion of their heating requirements. Even today, most new single family homes, particularly in rural areas, contain some type of wood heating device.

Nearly all of the earliest large non-residential wood burning installations in the province were established by energy intensive industries such as greenhouse operators or forest sector manufacturers who produce large amounts of waste wood as a byproduct of their operations.

Pulp and paper companies have always met some of their energy needs with low cost material such as bark, sawdust, shavings or chipped slabwood. Pulp and paper sector use of wood energy rose during the 70's and 80's as energy prices increased. In the early 1980's, STORA, then called Nova Scotia Forest Industries, began chipping diseased or low quality wood solely as a source of energy. This fuel was burned in a fluidized bed combustion unit with a capacity to co-generate 23 megawatts of power. This idea proved so successful that STORA now owns two chip harvesters and has supply contracts with private contractors who own seven mobile chippers. Other pulp and paper companies in the province are also investigating chipping equipment.

Spurred by high energy costs and advances made in the technology for wood fuel production, handling and combustion, wood use in the agricultural sector also increased. Most of the province's commercial greenhouse operations are heated with wood burning equipment including both of the two largest operations, Gordon's Greenhouses of Oxford, and Avon Valley Greenhouses of Falmouth. A number of smaller greenhouse operations also provide heat with either wood chips/residue such as W.J. Stolkdijk's

Greenhouses in Old Barns, Colchester County, or through the use of 100,000 to 400,000 Btu/hour manually fed hot air or hot water roundwood combustion equipment.

The agricultural sector also uses a small amount of wood chip residue for heating barns and other nearby farm buildings. Examples of this include Delhaven Farms in Pereau, Bill Pierek's farm in Scott's Bay, and other Annapolis Valley farms such as Haliburton Farms and Lowland Farms.

Modern wood burning technology is also being adopted at manufacturing and institutional facilities in the province. Scott Brothers Limited, a chicken rendering plant in Canning has been burning sawdust and/or wood chips since 1984. Britex Limited, one of the major suppliers of elastic fabric in North America, commissioned a wood chip burning plant in the summer of 1986. The Sunset Adult Residential Centre opened the province's first institutional wood chip heating plant in the fall of 1986. Construction is also in progress at three other new institutional sites: the Digby Elementary School; the Nautical Institute in Port Hawkesbury; and, the South Shore Regional Hospital in Bridgewater. Canexel, a South Shore hardboard manufacturer, is also installing equipment to burn wood dust from their manufacturing process.

Table 1 summarizes the estimated use of wood residue/chips in Nova Scotia in 1986. In addition to the wood residue/chip use summarized in this table, between 250,000 and 350,000 cords of roundwood are also burned by homeowners and other small energy users. Exact statistics for roundwood consumption in Nova Scotia are not available because of the large number of suppliers of the wood, the large number of people who produce fuel wood for personal use from their own woodlots and the large number of users.

Table 1
Estimated Wood Energy Use in Nova Scotia (1986)*

Name	Description	Green Tonnes of Wood Fuel	Type of Fuel
Stora Forest Industries	pulp and newsprint	350,000	hog fuel chips
Minas Basin Pulp and Power	cardboard pulp and paper products	5,000	hog fuel
Bowater Mersey	pulp and paper newsprint	153,000	hog fuel
Scott Maritimes	pulp	200,000	hog fuel
Avon Valley Greenhouses	greenhouse	15,000	chips, wood waste
Gordon's Greenhouses	greenhouse	25,000-30,000	wood waste
Delhaven Farms	hog farm	250	chips, wood waste
Bill Pierek	poultry farm	550	chips, wood waste
W.J. Stolkdijk's Greenhouses	greenhouse	500-1,000	chips, wood waste
Scott Brothers	fertilizer maker	1,800	chips
Britex Ltd.	textiles	6,000-7,000	chips
Sunset Adult Residential Centre	institution	900	chips
	Total	758,000 to 764,500 tonnes	

*round wood is not included in this table

Over the past several years, a number of fuel chip suppliers have been established as the market for chipped wood fuel has grown. There are currently five firms able to supply quality fuel chips on mainland Nova Scotia. These firms have the capacity to produce in the vicinity of 60,000 green tonnes of wood chips annually. As mentioned earlier in this section, nine chippers are also operating to supply STORA with fuel chips produced primarily from budworm damaged trees, logging slash and noncommercial species.

Chipper trials have also been held by Minas Basin Pulp and Power, Scott Maritimes Limited and the Nova Scotia Department of Lands and Forests.

Government Involvement in Wood Energy in Nova Scotia

Both the Federal and Provincial Governments have been actively involved in encouraging the growth of wood energy through studies, demonstrations, information transfer activities and assistance towards the capital costs of wood energy conversions. Without the financial and technical support provided by government, there is no question that wood energy would not be advanced to its current state in the province. A brief summary of wood energy developments occurring in the past eight years and government involvement in these developments is provided below.

Programs

1) Canada/Nova Scotia Subsidiary Agreement on Energy Conservation — this agreement funded three wood-related studies, two seminars, and eight demonstrations, including Avon Valley Greenhouses Limited.

2) Canada/Nova Scotia Oil Substitution and Energy Conservation Agreement Fund — this agreement funded a major demonstration of wood energy at Britex and supported the Fuel Chip Development Project. This project, a joint venture between government and the forest sector (represented by the Nova Scotia Forest Products Association and the Nova Scotia Woodlot Owners and Operators Association), has provided start-up funds to two wood chipping operations and sponsored two years of promotion and marketing activities. Activities have included two major seminars, production of two video tapes, the production of printed materials, and countless

presentations to civic groups, trade associations and other interested members of the public.

3) Canadian Oil Substitution Program (COSP) — this federal program provided financial assistance for more than 28,500 residential wood burning stoves and furnaces.

4) Forest Industries Renewable Energy (FIRE) Program — this federal program provided up to 20 percent assistance towards the cost of industrial conversions to wood energy. The pulp and paper industry in Nova Scotia used this program extensively.

5) Canada/Nova Scotia Memorandum of Understanding on Energy Conservation — this program provides $670,000 towards renewable energy projects. Wood burning projects authorized to date include two studies and a demonstration.

6) Canada/Nova Scotia Forest Renewal Agreement and the Canada Forest Resource Development Agreement — as part of these agreements, one million dollars was provided towards the conversion of public buildings in Cape Breton to wood energy. Research and development studies were also funded. Some types of woodchip harvesting activity are recognized as eligible for silvicultural incentives provided through these agreements.

7) Sales Tax Exemptions — at one time both the federal and provincial governments considered wood burning systems sales tax exempt.

8) Class 34 Accelerated Capital Cost Allowance — this provision in the tax code allows wood burning equipment to be fully depreciated in three years.

9) Energy From the Forests (ENFOR) — a national contract research and development program managed by the Canadian Forestry Service.

Another important government initiative was the formation of an interdepartmental committee to examine the feasibility of converting government owned or supported facilities to burn wood. This committee has completed a preliminary analysis of almost all large oil fired buildings owned or financially supported by the provincial government and has identified a number of promising sites for conversion to wood energy. A preliminary design and detailed costing has been completed for one of these sites. Additional work will also be done on other promising sites identified as funds permit.

Chip Supply

In the past, the supply of fuel chips has expanded to match the market for the product. Government assistance, in the form of a forgivable loan, was provided to the first two large operations formed to supply non pulp company consumers in order to offset anticipated losses incurred as a result of markets initially being too small to support an economically viable chipping operation.

Other major developments which have occurred include the formation of the forest management group ventures and the Government's new Forestry Policy announced last year. The development of a market for low grade wood fibre produced during forest improvement operations will support the objectives set out under this new policy.

The use of this low grade wood fibre as a source of energy will not only provide low cost energy to the province but will also complement the province's objectives in forest renewal and improvement. Forest land owners and operators have demonstrated their enthusiasm for the development of a wood chip market and their willingness to supply it.

A summary of wood related activities which have taken place in Nova Scotia since 1977 is provided in Table 2. Energy-related activities are cross-referenced to the programs listed earlier. The diverse nature of wood energy projects make it difficult to be sure that this list is complete. In the event it is not, the Select Committee apologizes to any individual or organization that has been inadvertantly omitted.

Table 2
Wood Projects in Nova Scotia Since 1977
(excluding the pulp and paper industry)

Project/Owner	Location	Program Assisted Under	Start Up Date	Description
A.R. Hemmings	Dartmouth	1	1979	Plant waste used to heat truss plant
Gordon's Greenhouses	Oxford	1	1979	First large non-pulp co. user of sawmill waste
Dafron Enterprises	Oakhill	1	1980	Production waste used to heat plant
W.J. Stolkdijk Greenhouses	Old Barns (Colchester County)	1		Greenhouse heated with wood waste/ chips
Mabou Gardens	Mabou	1		Greenhouse heated with roundwood
D. Porter & Sons	Stellarton	1		Building supply dealer
Hatfield's IGA	Springhill	1	1982	Grocery store heated with waste cardboard and wood
Delhaven Farms	Pereau	1	1983	Hog farm heated with wood chips/waste
Bill Pierek	Scott's Bay	1	1983	Poultry farm heated with wood chips/ waste
Scott Brothers	Canning	None	1984	Poultry rendering plant heated with chips/waste
Haliburton Farms	Wolfville	None	1984	Farm
Lowland Farms	Wolfville	None	1984	Farm
Avon Valley Greenhouses	Falmouth	1	1984	Greenhouse heated with chips/waste
Britex Ltd.	Bridgetown	2	1986	Manufacturing facility heated with chips

Project/Owner	Location	Program Assisted Under	Start Up Date	Description
Information Transfer				
Summary sheets for wood demonstration sites	N.S.	1	1982 1985	Provided interested parties with information about demonstration sites
Seminar on small wood burning systems	Kentville	1	Nov. 1982	50 people attended
Seminar — wood combustion	Wolfville	1	Feb. 1984	80 people attended
Seminar — Wood Energy Symposium	Truro	2	Mar. 1986	180 people attended
Seminar — Energy Opportunities '87	Halifax	2	Feb. 1987	Topics included district heating and innovative financing (175 people attended)
Videotapes — Institutional sites and Industrial/ agricultural sites	N.S.	2	1986	Promotional material developed for the wood chip supply development project
Government				
Select Committee of the Legislature to Study Wood Energy		n/a	1985 1987	Legislative committee to study benefits of wood energy and recommend action to the Legislature
Sunset Adult Residential Centre	Pugwash	None	1986	Institutional site heated with chips
Digby Elementary School	Digby	n/a	1987	New building — contract awarded
South Shore Memorial Hospital	Bridgewater	n/a	1987	New building — contract awarded
Nautical Institute	Port Hawkesbury	n/a	1987	New building — contract awarded

Project/Owner	Location	Program Assisted Under	Start Up Date	Description
Wood energy conversions to public buildings	Cape Breton	6	1987	$1,000,000 to be allocated towards capital costs of wood conversions — sites to be selected
Provincial Forest Nursery	Middle Musquodoboit	n/a	1987	New facility — design stage
Millbank High School	Lower Sackville	n/a	1987	New building — wood system in design stage
Wood Fired District Heating Demonstration	to be selected	5	1988	Planning stage only
Chippers				
Barrett Ent. Limited	Lr. Sackville	2	1986	Fuel chip harvesting operation
McMullin-Barnhill Forest Products	Truro	2	1986	Fuel chip harvesting operation
Annapolis Valley Wood Fuels Limited	Port Williams	None	1986	Fuel chip harvesting operation
Scott Maritimes Limited	N.S.	None	1985 1987	Field trial of several types of wood harvesting equipment
An Economic Impact Analysis of Wood Chip Harvesting & Use	N.S.	NSDME budget	1986	Study identifies substantial economic growth possible through growth of wood energy in Nova Scotia
Wood fired co-generation study	N.S.	5	1986 1987	Study will look at 3 sites in detail to determine costs and benefits of wood as well as determine the overall potential for co-generation in N.S.

Project/Owner	Location	Program Assisted Under	Start Up Date	Description
Design study of wood chip conversion of Nova Scotia Agricultural College	Truro	NSDGS budget	1987	Study did preliminary design of wood burning heating plant
Study to examine the barriers to greater use of wood energy	N.S.	5	1987	Barriers to the increased use of wood energy will be determined through analysis of 18 industrial and institutional sites
CFB Cornwallis Feasibility Study		NSDME budget	1986-87	Study to determine feasibility of converting CFB Cornwallis to wood chip energy
Tatamagouche District Heating Study		Depts. of Social Services and Lands & Forests	1986	Study to determine feasibility of heating a group of public buildings with a central wood fired heating plant
Ralph Thompson	Pugwash	Rural Industry Program, Dept. of Development	1986	Fuel chip harvesting operation
Bear River Woodlands	Bear River	None	1987	Fuel chip harvesting operation
Studies				
Using Wood for Energy	N.S.	NSDLF	1977	
Wood Energy Plant Study	N.S.	DRIE/ NSDOD	1978	
Co-generation Study	N.S.	1	1981	Examined feasibility of co-generation for a number of fuels under conditions at that time

Project/Owner	Location	Program Assisted Under	Start Up Date	Description
Increased Use of Wood as an Energy Source	N.S.	1	1981 to 1982	Identified forest residue suitable for chipping as a major potential energy source
Gordon's Greenhouses	N.S.	1	1981	Chipper trials
Forest Residue Wood Substitution Study	N.S.	1	1983	Three sites identified for detailed study. Two of these sites have since converted to wood
Field Chipper Trial — Minas Basin Pulp and Power Limited	Hantsport	None	1985	Seven week field trial of mobile drum chipper
Field chipper trial under Lands & Forests supervision	N.S.	6	1985	Field trials of tractor power chipper
Antigonish District Heating and Co-generation Study		None	1986	Examined the potential for district heating and co-generation in Antigonish. Major energy users include the new St. Martha's Hospital and St. Francis Xavier University
Wood Energy Opportunity Analysis in Cape Breton		6	1987	Study to determine the feasibility of converting institutional sites to wood
Forest Biomass inventory of Oxford area		9	1979	

Project/Owner	Location	Program Assisted Under	Start Up Date	Description
Effects of harvesting biomass for energy on the nutrients status and long term productivity of forest sites		9	1980	
Trial conversion of conventional inventory data to biomass data in Nova Scotia		9	1983	
Compilation of Forest Biomass inventories for N.S.		9	1984	
Inter-departmental Committee		n/a	1986 1987	Committee to examine the feasibility of converting government funded buildings.

The government has maintained its committment to wood energy despite changing oil prices and their effect on the overall financial attractiveness of wood energy conversions. As more experience is gained with wood energy at institutional sites, additional funds for capital expenditures become available and oil prices return to historical levels, it is anticipated that the rate of conversion of government owned and supported installations will increase.

Wood Fuel Use Technologies

Wood Combustion — Heating Only

Modern wood burning equipment incorporates principles of solid fuel combustion which have been in use for many years. Processing wood into a relatively uniform and homogeneous fuel (wood chips) allows fuel delivery and combustion to be automatically controlled in modern wood burning systems. Improvements in fuel handling technology, and control technology have made wood burning efficient, clean and much more responsive to variations in heating loads than older systems, although still not as responsive as oil.

Combustion control is achieved primarily through the volume and location of the primary air supply, the amount of secondary air supplied, the rate of fuel delivery and the amount of draft created by the induced draft fan. Systems range in complexity from high/low fire controls with manually adjusted air controls to microprocessor controlled modulating air and induced draft supply systems which respond to the flue gas composition and temperature sensors located on the stack and within the combustion chamber. As a general rule the cost of complex control systems can only be justified for larger installations.

Ash removal from the combustion cell is achieved using devices which range from manually operated steel scrapers to automated systems with moving grates which transport the ash to a collection pit. Ash collected either drops directly into a container or is transported via screw conveyor to a remote container.

Wood ash is not considered toxic and is used as a fertilizer in many jurisdiction. Total ash depends primarily on the volume, quality, and cleanliness of the fuel burned. High quality whole tree chips produce 0.5 to 1.0 percent ash by volume. Ash produced from burning dirty bark can be as high as four or five percent.

Exhaust gases produced by modern wood chip fired combustion systems, unlike residential air tight stoves fueled with roundwood, have a minimal effect on the environment. The keys to this improvement are to carefully control the air supply to the combustion chamber and to ensure high combustion chamber temperatures, typically 1500-2000 degrees fahrenheit. This leads to combustion taking place under ideal conditions and results in the

major products of combustion being carbon dioxide and water. Sulphur emissions are low, since wood contains only trace amounts of sulphur.

Particulate emissions from modern wood chip systems are minimal since nearly all systems larger than 30 boiler horsepower have cyclone separators to trap particulate matter carried out of the combustion chamber by the hot exhaust gases. The collected material normally is disposed of with ash from the combustion chamber.

The most cost effective wood systems are sized to meet the base load of the particular facility. Peak loads and backup continue to be supplied by the facility's existing heating system. Sizing the wood system to meet only a portion of the peak heating load leads to operation close to full capacity for a greater portion of the year. This results in better overall efficiency. This approach works well for facilities with primarily space heat loads. Usually 80 to 90 percent of their annual heating requirements can be met with a boiler sized between 40 and 50 percent of peak heating needs.

The most economic application for wood energy is in a facility with a steady, round the clock, 365 day per year load. Facilities with extremely variable loads may not be appropriate locations for a wood energy heating plant.

Boiler sizing and wood chip energy plant design are specialized subjects and expert advice should be obtained before proceeding with a project.

Co-generation

Co-generation is the simultaneous production of heat and shaft power. The shaft power is usually used to either run machinery or generate electrical power.

The advantage of co-generation is that the overall system efficiency of a properly designed co-generation system producing heat and shaft power together is much higher than if it was done separately. The key to achieving the efficiency improvements possible is to have a simultaneous use for both the shaft power and the heat produced.

Co-generation, as applied to wood energy, normally refers to the generation of heat and electricity. In a modern, fossil-fueled, central power station generating electricity only, typical efficiencies are generally 30 to 40 percent. Approximately 9500 to 10,500 btu's are required to generate a kilowatt hour of electricity. Properly designed power plants which co-generate electricity and heat can have overall efficiencies over 70 percent and require only 4500 to 5000 btu's per kilowatt hour of electrical power generated.

This improvement in overall efficiency can only be achieved if both the heat and electricity can be used. If excess heat has to be wasted, a portion of the efficiency improvements will be lost. For this reason, the size of electric generation capacity of a co-generation plant is usually based on the amount of thermal load at the site. This was the practice in Sweden for sites having co-generation capacity in association with district heating central plants.

Co-generation installations are usually most attractive for large industrial sites or district heating networks due to the high capital cost of co-generation equipment and the need to match simultaneous electrical and thermal loads for efficient operation. Nova Scotian examples of co-generation are at Scott Maritimes Ltd., STORA Industries and Bowater Mersey Paper Company Limited.

The possibility of co-generation should be examined at any site showing promise, but unless oil costs and retail power rates increase substantially above current levels, co-generation would appear to be economically marginal under current conditions.

District Heating

District heating systems heat a number of buildings from a central heating plant. The central heating plant can use a number of different sources of energy to produce the heat needed by district customers from several fuels including wood, oil, coal, garbage, peat, heat pumps or waste heat from both co-generation or industrial processes. Usually heat for a large district heating network is supplied by more than one of the above choices. This flexibility in choice of energy source is one of the major advantages of district heating.

In Sweden, district heating is very common: more than one half of Sweden's municipalities and cities are served by district heating networks. Swedish and European technology is quite different than the technology used in older district heating systems found in North America. Swedish systems use hot water as the heating medium in a closed loop system. Pipes are usually buried and have leak detection systems to discover potential corrosion problems before they become serious.

Old North American systems usually use steam as the heat transfer medium. Steam systems require more maintenance, are more expensive to meter and have greater heat losses. District heating systems of this type are common at military bases or universities.

The widespread use of district heating in Sweden is a result of the Swedish government's decision to reduce the country's dependance on imported energy. Most systems are municipally owned, non-profit utilities and

are integrated with one or more large industrial users. District heating networks include consumers as small as individual residences. The Borlange district heating network visited by the committee served a total of 33,000 households, as well as commercial, industrial and institutional users.

District heating networks relieve individual energy users of the cost and responsibility of maintaining their own heating systems. Individual consumers no longer need their own separate heating systems but only need distribution systems. Heat is supplied from the district heating network to the individual energy user's distribution system through heat exchangers located on site. Heat use is metered and the consumer is charged for the heat used; very much like electrical power is sold to consumers by the Nova Scotia Power Corporation.

A nearby example of a Swedish style district heating network was commissioned in Charlottetown in 1986. This system heats 16 buildings in downtown Charlottetown with a wood chip boiler plant and the second phase has already been announced.

While it is difficult to envision city wide district heating networks in Nova Scotia in the foreseeable future, the Committee feels that opportunities for district heating in selected areas exist and should be pursued if economically viable.

Heat Storage

Heat storage allows peak energy requirements to be produced during off peak periods. Heat produced when the load on the heating plant is less than its maximum output is stored as hot water. This hot water can then be used when needed during peak periods. Storage tanks are often pressurized to raise the maximum temperature of stored water.

An example of hot water storage in Nova Scotia is located in Scotia Square. Four 10,000 U.S. gallon heating tanks store hot water at night to reduce Scotia Square's peak electrical use during the day and evening.

Wood Chip Harvesting Equipment

During the course of its investigations, the Committee saw a wide range of approaches to harvesting and transporting chipped wood fuel.

Chip harvesting equipment is available in size ranges from small manually fed chippers attached to tractors to large chippers capable of chipping trees 20 inches in diameter or larger. Large units have high capital costs but lower labour costs while smaller chippers are the opposite.

Chipper styles tended to fall into two categories: landing style chippers which load delivery vehicles directly and require the wood to be brought from the stump to the landing; and mobile chippers which go directly to the stump and transport the finished chips back to delivery vehicles at the landing.

Both disc and drum chippers were common. Drum chippers generally have smaller capacities and lower outputs but produce a more uniform chip. Disc chippers have larger capacities and higher outputs but under many conditions produce some oversize slivers of wood. These slivers will cause fuel handling problems in most small or mid-sized wood chip burning installations. For this reason, oversize slivers must be screened and either discarded or reduced in size at some stage of chip production or at the wood consumer's storage area on delivery.

The Committee also saw chips being produced from a wide range of different sources of wood fibre. In Sweden, only the poorest quality wood fibre and tops and branches were used for fuel chips. Better quality wood was sorted and used for products yielding a higher economic return. Chips in other jurisdictions were produced from wood with little commercial value in that particular area. This wood tended to be larger non-commercial species and could be either hardwood or softwood, depending on the region.

Methods used to transport chipped fuel and wood waste also varied substantially from region to region. Equipment configurations selected varied depending on hauling distance, equipment available, consumer unloading facilities, highway regulations and chipping equipment.

The optimal choice of chip harvesting equipment clearly varied depending on consumer chip requirements, stand configurations, haulage considerations, and a number of other factors.

The committee also saw storage terminals in many of the areas visited. This creates a buffer between supplier and user to ensure a continuous supply of chips to consumers during periods when chip production drops due to equipment breakdown, weather or other difficulties. Experience in Maine and Sweden has shown the development of large scale integrated energy systems will lead to the creation of off-site storage facilities, fuel brokers and the ability to accept a variety of fuel types.

It appears further study, field trials, and observation of chipping operations will be required before the optimal solutions to chip harvesting and delivery under Nova Scotia circumstances are clear.

Wood Fuel Supply & Demand

Supply

In their presentation to the Select Committee on October 9, 1985, the Department of Lands and Forests outlined a significant supply of forest residue and non-commercial species available to produce wood chip for wood energy users. The use of this biomass as an energy source need not affect the supply of wood fibre for current commercial purposes. The estimated annual supply of 1,835 thousand green tonnes of biomass material available for energy use is made up as follows:

1. 615,000 green tonnes of logging residue from both softwood and hardwood cuts

2. 940,000 green tonnes of surplus hardwood up to the Allowable Annual Cut

3. 280,000 green tonnes of residue from silviculture operations and harvesting of uneconomical species and stands.

Approximately 29 percent of this volume is available from crown lands, 33 percent from private lands and 38 percent from small private landowners. The numbers shown above for annual availability of biomass have been adjusted for inaccessibility of some forest stands and the assumption that not all private land owners will participate in supplying biomass fuel material. This volume of biomass fuel is equivalent to approximately 2.4 million barrels of heating oil or slightly more than 30 percent of Nova Scotia's 1985 consumption of light and heavy fuel oils.

Demand

The current demand for biomass material used as an energy source is between 758 and 765 thousand green tonnes excluding the use of roundwood in residential applications. Of this total, slightly more than 700 thousand green tonnes is being consumed by the pulp and paper industry. The majority of this

amount, approximately 500 thousand green tonnes, is hog fuel purchased from mills or produced from their own operations. Therefore, estimated annual consumption of chips harvested and used for energy production is between 258 and 265 thousand green tonnes.

Given reasonable development of the wood chip fuel industry in Nova Scotia, the future demand in the non-forest industry sectors could reach between 700 and 1000 thousand green tonnes annually. This is equivalent to between 1 and 1.3 million barrels of heating fuel and is between 12 and 17 percent of our annual requirements for heavy and light fuel oils.

In order for development to proceed to these levels, it will be necessary for the Government of Nova Scotia to encourage conversions in the private sector, and convert government supported facilities where and as these conversions are financially attractive. Encouragement in the form of information and assistance with feasibility analysis along with increases in the price of conventional fuel sources will achieve the maximum participation in conversion activity. Costs incurred for information transfer and feasibility assistance will be recovered as increased economic benefits from the use of an indigenous fuel resource.

Costs

Costs of Fuel

The cost of wood chip fuel in Nova Scotia runs between $24 and $30 per green tonne delivered. This is comparable to the cost of wood fuel in other Atlantic Provinces and the eastern region of the United States. Large users (8000 tonnes/year plus) accepting large (15 to 25 tonne) loads of chips can expect to be able to purchase chips at the lower end of the scale while small users should expect to pay upwards of $30.00 per tonne. Small users located in remote areas with no other wood burning installations nearby may have to pay even more than $30.00 per tonne. Trucking distances greater than 80 kilometers will also increase costs.

Wood waste or bark is available in some areas of the province at reasonable cost ($13.00 to $20.00 per tonne delivered). Additional fuel handling costs, increased ash removal requirements and reduced heat content of this lower grade fuel will add to the user costs. These factors should be carefully considered before deciding on the choice of fuel for an installation. In addition to this, wood waste/residue is a by-product and may not be continuously available throughout the year, so storage facilities are often required.

Necessary storage and additional handling required could add substantially to the cost of the fuel.

Fuel costs in Sweden tended to be higher than in North America because the fuel was normally produced almost exclusively from small diameter material such as tops and branches which are more expensive to chip.

Wood Harvesting Equipment Costs

The cost of wood chip harvesting equipment varies with the level of mechanization and the size of equipment. On a per unit of output basis, the labour component of larger equipment is lower, but its capital costs will be higher. The optimal choice of harvesting equipment will be influenced by the size of the chip harvesting firm's market, the type of material being chipped and any available equipment than can be integrated with the chip harvesting operation.

Mobile drum chippers mounted on tandem wheel forwarders generally cost $260,000 to $270,000 each. These units are best suited to chipping logging slash but have the flexibility to chip a wide variety of materials.

Landing style chippers, complete with grapple, range in cost from $100,000 to $120,000. This type of equipment requires that the material to be chipped be brought to the chipper using conventional forest equipment such as skidders and forwarders. The additional costs of this equipment, if bought new, would raise the total cost of equipment to levels comparable to mobile chippers.

Smaller chippers powered by tractors cost between $10-15,000 and $60,000, but have limited volumes of production, particularly if they are fed manually rather than with grapple arms. The value of these chippers for whole tree chipping is limited due to restrictions in the size of tree that can be chipped.

Chips can be transported to the consumer using a variety of combinations of vans or trucks. An important factor in the choice of equipment will be the unloading facilities and fuel storage capacity of the chip consumer. Used equipment may be available or chip transportation can be subcontracted to local trucking firms. If purchased new, a truck and two self unloading chip vans can be expected to cost between $180,000 and $210,000.

Wood Combustion Equipment Costs

Capital costs for wood fired heating plants are much larger than those of an oil fired system, primarily because of the cost of the fuel handling system and storage facilities. The costs of a wood boiler plant of a particular size depends on factors such as the complexity of controls, size of boiler, volume of fuel storage desired, existing conditions at the site, variability of the load on the boiler and quality of components.

Generalizations which can be made about capital costs are:

1) larger boilers will have a much lower cost per boiler horsepower than small systems

2) systems which provide space heat only and are smaller than 40 to 50 boiler horsepower are generally not financially attractive using currently available equipment

3) sophisticated controls and automatic ash handling are generally too expensive to be included on any but the largest systems.

Estimates of boiler costs for a basic wood chip burning boiler plant and fuel handling system are provided below. Additional screening, storage, or fuel handling requirements needed to burn poor quality wood fibre such as bark, or mill waste will increase costs above those in the table. Packaged or containerized boiler plants available in smaller sizes show promise of reducing costs for smaller installations.

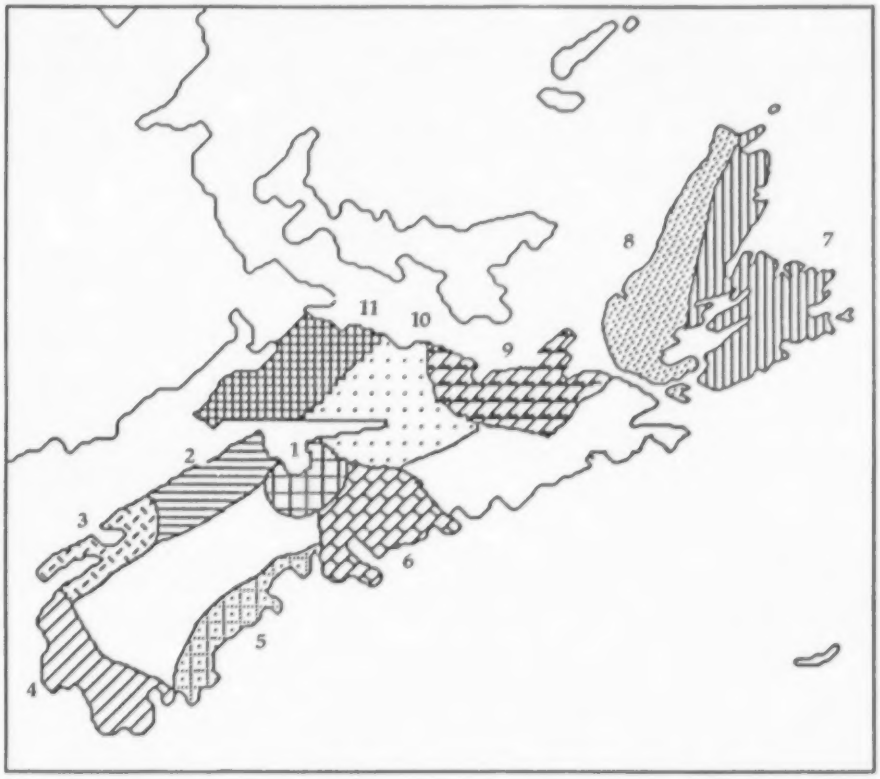
Conversion Costs for Wood Chip Boilers

Boiler Horse Power	Estimated Cost ($)
100	410,000
125	450,000
500	750,000
1000	1,300,000

Systems installed in new buildings will be less expensive because the cost of a system integrated into the design of a new building will usually be lower than the cost of a conversion after the facility was built. In addition to this some equipment costs for a conventional system will have been avoided by installing the wood system. This may also be possible at some conversion sites if, for example, major boiler replacement or maintenance costs could be avoided or additional boiler capacity would be required for building extension. The costs of these measures, which would otherwise be needed, can be deducted from total costs to determine true out of pocket costs.

Wood-chip supply in sub-regions

The regions were selected according to the geographic proximity of prospective woodchip users. Local concentrations of users were assumed to be a necessary condition to encourage local suppliers of woodchips to take up the business. However, the geographic pattern used to classify demand is meant to serve mainly as an analytical device for matching potential demand with local wood supply conditions. It is not meant to be a prediction of local supplier response. Still, given the limitations imposed by transportation costs, demand will almost certainly be supplied from within a 50 mile radius of the woodchip consuming site.



1. Windsor — Hantsport
2. Kentville-Wolfville-Berwick (Kings County)
3. Digby-Bridgetown-Middleton
4. Meteghan-Yarmouth-Shelburne
5. Lunenburg-Queen's County
6. Halifax-Dartmouth Metropolitan Area
7. Cape Breton-Victoria
8. Richmond-Inverness
9. Pictou-Antigonish
10. Truro-Tatamagouche (Colchester County)
11. Amherst-Springhill (Cumberland County)

Economic Considerations

Economic benefits from increasing the use of wood residue/chips as a source of energy will accrue to a number of segments of the provincial economy These include:

1) fuel chip production and delivery business

2) fuel chip consumers

3) manufacturers and installers of wood chip heating plants

4) the sale, service and manufacturing of wood chip harvesting and delivery equipment

5) the federal and provincial governments through increased tax revenue and cost reductions for forestry programs.

Analysis of the economic impact of wood chip harvesting and use of 1986, quantified the direct, indirect, and induced economic impacts of increased use of wood chips as a source of energy and assessed manufacturing and business opportunities which could be generated. This permitted the development of estimates of the effects of the increased use of wood energy on the provincial economy as a whole rather than just assessing benefits from the energy consumer's perspective only.

Adequate levels of woodchip supply have been estimated for eleven sub-regions of the province of the province. (see map on previous page)

1) **Fuel chip production and delivery** — Net total effect on annual basis from wood chip supply delivery operations was estimated to be 73 person years of employment and more than two million dollars in household income per hundred thousand green tonnes of fuel use.

2) **Fuel chip consumers** — Savings generated from the substitution of wood energy for another fuel can be substantial. The exact value of savings depend on the cost of the competing fuel. Initially any savings from an installation would be used to pay off it's capital costs. After capital costs have been paid off, the savings would be available for

other purposes and would benefit the local economy. Estimating the impact of these funds is difficult because the amount, availability and use of these funds will vary from user to user. The effect of the savings will be substantial in the future since the normal lifespan of wood burning boiler plants is 20 to 30 years.

3) **Manufacturers and installers of wood chip heating plants** — Economic benefits from this activity are substantial but occur only when the installation is built and do not reoccur on an annual basis. On average, approximately 9.5 person years of indirect and induced employment and $320,000 in household income would be created per million dollars spent on wood chip energy conversions. If the Nova Scotia content of these systems rises above current levels, the economic benefits would increase.

4) **Wood chip harvesting and delivery equipment** — Approximately 14 indirect and induced person years of employment jobs and $310,000 of household income will be generated by every $1,000,000 dollars spent on wood chip harvesting equipment. This economic benefit should reoccur at $91,700 per million dollars of investment and $520,000 to $540,000 dollars annually per 100,000 green tonnes of wood chips burned. Although not quantified in the impact analysis, wood chip harvesting can help to reduce the costs of subsequent silviculture requirements. This will enable this necessary work to be undertaken at lower cost to government or at an accelerated rate.

5) Benefit to woodlot owners — The economic benefit to woodlot owners by expansion of the woodfibre sector of the forest industry would be significant in a number of ways: the opening of a new market, additional cash flow to support lot improvement, greater use of equipment, and a higher income from increased output and improved quality of product.

Clearly, the potential economic benefits of wood energy are substantial. As the use of wood energy increases, economic benefits to Nova Scotia can be maximized by increasing the Nova Scotia content of equipment as much as possible and insuring that to the greatest extent possible, the energy displaced by wood energy is currently obtained outside the province.

Forestry Implications

The world loses thousands of acres of forest land every year from airborne pollutants, drought, neglect, and irresponsible exploitation. Some of these losses affect Nova Scotia directly and they illustrate how vulnerable our woodlands are. The threatening elements to which neglected woodlands are vulnerable, provide stimulus for enlightened forest management.

Other countries including Sweden have been able to double the output and vastly improve the quality of their woodlands through programs that were begun in the nineteen twenties. Such foresight pays off and our forest management policies established ten years ago are now beginning to pay dividends.

While forest management programs are relatively new to North America it is already evident that yields can be doubled or tripled using modern techniques. These programs would reduce losses from insects, and fire hazards and materially improve growth rates. Biomass harvesting has the additional advantage of helping to support silviculture practices by complementing the range of economically feasible activities.

The estimated supply potential of fuel wood in Nova Scotia is based on the harvesting of biomass currently not used for pulpwood, sawlogs or other commercial product. The supply includes slash (tops and branches), non-commercial species, unmerchantable stands, cull, diseased, or rot-damaged timber as well as trees too small for any commercial use and with poor prospects of growth.

There appears to be consensus among industry and government forestry specialists on this continent and in Europe that forest management is essential to maintain the future quantity and quality of product. In Sweden this has resulted in 50 percent more fibre than the nation's woodlands had in 1920.

Silviculture is just one tool of forest management. Stands of non-commercial quality are best removed for wood fuel use and the site can be re-planted with more appropriate and productive species.

An estimated ten percent of Nova Scotia's productive forest stands are more than sixty years old, have a volume of less than 10 cords to the acre and are not commercially suitable. Some of these stands could be salvaged and the

sites regenerated with desirable species. Whole tree chipping, integrated with a conventional harvest operation, would minimize the cost of restoring these sites to full productivity.

The harvesting and replacement of unsuitable species and the salvage of insect-damaged stands would be a further source of wood fuel without affecting current or estimated future requirements of pulpwood and sawlogs.

Forest management will improve the environment for wildlife and generate public pride in our woodlands which will help to reduce vandalism and careless harvest practices.

There would be recognition by local people as well as tourists that we have an industry designed to improve and beautify our forest lands and to safeguard their contribution in the decades ahead. The concept merits support.

The Dean of Faculty of Forestry of the University of Toronto, Dr. J. R. Carrow, says it was only ten years ago that a national consensus emerged in the forestry sector that the forests of Canada were not being renewed or regenerated adequately to meet projected future demands for wood.

Dean Carrow says further that because forest management is so dependent on public funding, it is essential that a broad public understanding of forestry and its challenges be developed.

One concern among some foresters and others, is that high value forest stands may be chipped and the expansion of biomass harvesting will develop as a private enterprise operating on private land. The role for government in these circumstances, as with conventional logging, will be to promote and encourage good practices and utilization on private land and require such practice on public land. This concept has been clearly spelled out in the New Forest Policy and forest legislation. Market forces will also help to determine the most appropriate economic utilization.

We are at a time of decision, a period of transition in forest conservation and management. We have a long history of exploitation with little concern for renewal or conservation. We have followed the practice of "take the best, leave the rest" because there was no incentive to spend time or effort on regeneration as long as there was a limitless supply of timber available. More money has been spent on forest renewal and management in recent years but we have to increase the pace of improvement if our forests are to reach their full potential.

Conclusions

The use of biomass fuel in Nova Scotia would appear to be best suited to substitution for oil purchases from foreign sources. The cost of oil will have a substantial influence on the movement toward alternative fuels but there is a further consideration. Do we in Nova Scotia want to have some insurance against the further possibility of wildly fluctuating petroleum prices as experienced in the recent past?

A former chairman of Petro-Canada and a figure of international reputation, Maurice Strong, observes that the yearlong reduction in oil prices that began in November of 1985 was a breathing space for oil-importing countries to begin reducing their dependency on imported fuel by diversifying their energy supplies and increasing use of indigenous fuels. He adds however, that the period of relatively lower oil prices also reduced the immediate incentive to pursue other sources.

It would be difficult to assess the return of complacency that has developed since oil prices dipped, but a recent comment by an observer of energy matters noted that North Americans are again asking for larger automobiles and the enthusiasm for fuel conservation is somewhat muted. It is not a time to neglect the lessons of the recent past that illustrate the volatility of world oil prices.

Five years down the road, the cost of imported oil may well approach or possibly exceed the highest rates experienced in the past decade. The precarious terms of OPEC agreements and Persian Gulf conflicts could result in the catastrophic interruption of supplies and sky-rocketing prices at any time. World oil prices are even more vulnerable to such conditions since oil production in non OPEC areas is declining and the pace of exploration has slowed due to reduced industry cash flow.

There are predictions by the National Energy Board that by the early 1990's, Canada will face a supply deficit of light crude amounting to more than four hundred thousand barrels a day, about thirty percent of demand for light crude. This estimate adds a further concern to an already delicate oil market.

Within that premise, our annual cash outlay for petroleum fuel (excluding products used for transportation, highway, rail, airline, and marine bunker) will remain high and we will be dangerously vulnerable to another

price/supply crisis. At the moment, there is no alternative for propulsion fuels but appreciable savings and security could be realized from wood fibre usage for district, school, hospital and industrial heating.

Biomass fuel represents an opportunity to materially reduce dependency on oil imports. The amount of biomass fuel available on a sustainable yield has the potential to displace approximately twenty-five to thirty percent of our non-transportation refined petroleum product use, all of which is currently met by imports.

In demonstrations so far, biomass fuel has been found to be a cheaper energy source, from an operating cost perspective, than oil for heating factories and institutions such as hospitals and schools and is a secure source of energy that is insulated from severe fluctuations in petroleum prices. Unfortunately the current low cost of petroleum fuels prevents recovery of the relatively high capital cost required to convert an existing oil system to wood combustion in most cases. This situation emphasizes the need for careful and accurate investigations on a site specific basis for each facility proposed for conversion. Other factors including estimated biomass reserves, projected annual growth, processing and transportation costs and the wood fuel pricing structure required to sustain labour costs and justify capital investment by fuel suppliers, also need to be addressed.

The orderly and concurrent development of product availability and market opportunity is essential to an effective conversion program. Biomass production should be regarded as complementary to the established forest industry, additional to the harvest of sawlogs, roundwood, and wood chips required for pulp and paper manufacturing. Traditional forest markets should have priority of supply. Wood fuel demand may be more than adequately supplied using residue unsuitable for other uses.

The development of biomass harvesting practices should continue to be reviewed to ensure that they are compatible with improved silviculture and forest management practices and to ensure proper resources utilization over coming decades.

Environmental considerations including the protection and conservation of wildlife in the natural habitat and the productive capacity of forest sites should be included in the overall examination of wood fibre usage in Nova Scotia. It is this generation's responsibility to conserve provincial forests for the education and recreation of future generations.

It is with consideration of these matters and the experience of other provinces, the State of Maine, and Sweden, that the Committee develops the consensus that forest biomass represents a significant source of energy in the Province of Nova Scotia. Use of forest biomass was 8% of end use demand for energy in Nova Scotia in 1985. The development of forest biomass energy need not compete with current or future use of other indigenous energy

resources in the Province. Each can be developed to its fullest viable potential to provide the maximum benefit to Nova Scotia and Nova Scotians.

In order to maximize the benefits of conversion to wood chip combustion, a number of potential issues must be addressed from the consumers point-of-view.

1. Feasibility, both technical and financial for each site specific case.
2. The idea that conversion to wood fuel is a backward step.
3. The concern of many about adequate fuel supply on a secure basis.

These concerns can be met with an appropriately designed information program and assistance for feasibility analysis to generate specific information for individual sites. A specialist with knowledge of wood combustion technology could be retained to provide information to potential users, to undertake preliminary screening analysis of specific sites, and to act as a means of co-ordination between suppliers and consumers of wood fuel.

The Department of Lands and Forests should continue to develop information and data on the nature and availability of biomass fuels. This capability can be integrated with the Department's existing conventional inventory and research programs.

Based on an acceptable pre-feasibility analysis, completed by the specialist using in-house computer capacity at the Department of Mines and Energy, a detailed feasibility study could be completed for the facility by a consulting engineering firm with financial assistance provided by the Provincial Government. This would provide sites worthy of consideration, with the means to investigate wood combustion conversion for their individual situation, while at the same time avoiding the very high cost associated with a large number of potential sites not screened by a pre-feasibility criteria. Provision should also be included for consulting foresters to identify the volume and probable cost of the various wood fuels that will be viable for each installation.

To provide support for the program outlined above, and to ensure that government effort in promoting the use of forest biomass fuel is effective, a committee made up of members from provincial government departments could be formed to co-ordinate all government activities. The chairman of this committee should be appointed from the Department of Mines and Energy.

There is a preponderance of opinion backed by professional assessment that the use of forest residue could be substantially increased without interference with or reduction in the quantity of merchantable wood

available now and in the future for the pulp and paper industry, for sawmill operators and for miscellaneous use (poles, pilings, etc.).

On the basis of these conclusions, this Committee offers the following recommendations:

Recommendations

Based on presentations received, visits made and our deliberations, the Select Committee recommends the Province of Nova Scotia adopt as policy the following recommendations:

1. Establish a management committee from provincial departments to co-ordinate the implementation of government activities in the use of energy from wood fibre combustion, with a chairman representing the Department of Mines and Energy.

2. Establish a program of support for feasibility studies of wood fuel substitution where preliminary analysis indicates favorable opportunity for conversion.

3. Provide funding assistance for the demonstration of wood energy technology where appropriate to encourage conversion or initial installation.

4. Investigate the potential for district heating systems in Nova Scotia and their impact on the use of wood fuel energy, employing appropriate demonstration sites.

5. Encourage the conversion of government owned or supported facilities where wood fuel substitution is cost effective.

6. Undertake chipper demonstration trials, in conjunction with the private sector and woodlot owners, under a range of stand conditions and equipment configurations to help determine harvest productivity and operating costs.

7. The government and private sector should, together with the Commissioner of Forest Enhancement, encourage, promote and monitor the use of forest fibre to ensure the highest utilization of forest fibre in Nova Scotia and the enhancement of the forest.

8. Avoid large scale (above 10 MW) electrical generation from wood fuel but encourage co-generation where favourable economics exist.

9. Designate a wood energy specialist attached to the Department of Mines and Energy, to be available for advice, pre-feasibility analysis, co-ordination of user/supplier contacts, and to provide a source of technical information.

10. Provide information and advice on request to potential suppliers of wood chip markets through existing marketing specialists in the government department of Lands and Forests.

11. Encourage the Government of Canada to continue the accelerated tax write off provisions for wood fuel use or to enhance this measure with other forms of appropriate incentives.

12. We recommend in conclusion that due recognition be given to the demonstrated economic advantages of forest management, job creation, and spin-off benefits to Nova Scotia.

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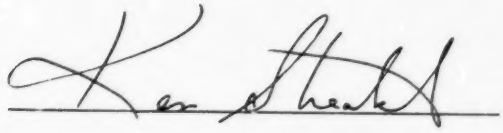
Signed:

The Hon. Ken Streatch,
Minister of Lands and Forest



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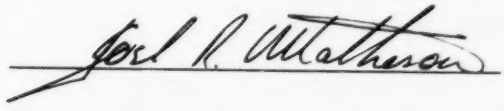
Minister of Mines and Energy



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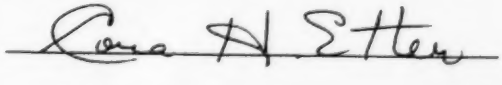

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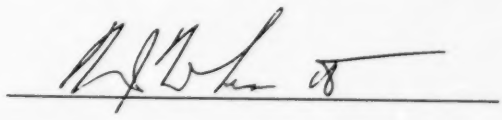

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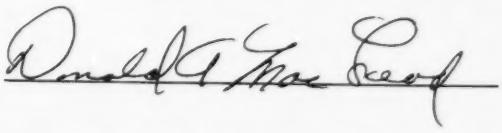

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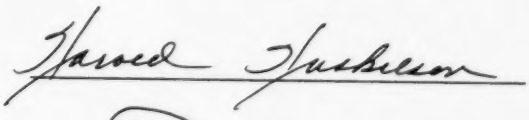

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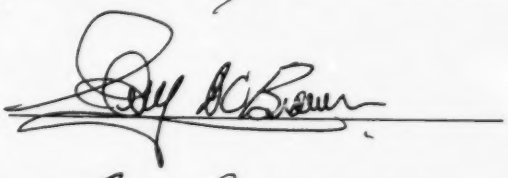

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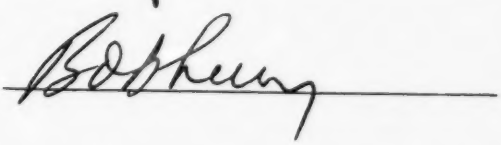

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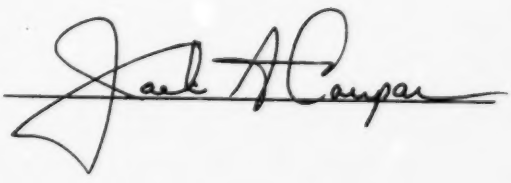

Halifax, N.S., May 15, 1987

Acknowledgement of Courtesies and Assistance to the Committee

Mr. Gorin Mornhed of AF Energikonsult, Charlottetown, Swedish tour adviser and guide.

Ms. Anne-Charlotte Hultin, AF Energikonsult Coordinator, Stockholm.

Mr. Lars Astrand, Uppsala Energi.

Mr. Rolf Annerberg, Under-Secretary of State, Stockholm.

Mr. Soren Eriksson, Trosa, Sweden.

Mr. Hans Troedsson, Trosa, Sweden.

Professor P.O. Nilsson, Garpenburg, Sweden.

Mr. Olle Olsson, Garpenberg, Stora Enterprises, Garpenberg, Sweden.

Mr. Leif Johansson, Borlange, Sweden.

Mr. Lars Lindgren, Norsundet, Sweden.

Mr. Bertil Westin, Norsundet, Sweden.

Mr. Carl Mattson, AF Energikonsult, Stockholm, Sweden.

Mr. Gorham Hedman, S.S. Energi, Ronneby, Sweden.

Mr. Ulf Johnsson, Municipal District Heating, Vaxjo, Sweden.

Mr. Duncan MacAdams, N.S. Forest Products Association.

Mr. Rob Brandon, General Manager, and Associates of the Prince Edward Island Energy Corporation.

The Committee also extends thanks and appreciation to the other officials and personnel of operations visited in Nova Scotia, Prince Edward Island, and Maine. Their detailed arrangements and coordination of site demonstrations were most helpful and provided much useful information.

If names of individuals or organizations who assisted the committee in its site visits have not been acknowledged, the Committee wishes to offer sincere apologies for any inadvertence.

Glossary

Annual Allowable Cut The "AAC" is an estimate of the amount of merchantable wood that can be extracted from the forest without depleting the resource. It is based on forest inventory data, the rate of growth in the forests, and assumptions such as timber accessability, woodlot owner participation and loss of wood to disease, windfalls, etc. Most of the wood used to produce wood chips is not merchantable wood and therefore is not included as part of conventional AAC calculations.

Biomass Combustion The extraction of energy for a useful purpose by burning biomass material in a controlled manner. Heat transfer is usually achieved by hot air, hot water or steam.

Biomass Fuel Fuel derived from plant material, usually wood.

Co-generation The simultaneous generation and use of heat and shaft energy from fuel combustion. The shaft energy produced is usually used to generate electricity or power machinery.

District Heating The connection of physically separated buildings to a central source of heat. Heat from the central heating plant is usually delivered to users through underground pipes containing hot water or steam.

Forest Residue Biomass material remaining after wood harvesting or processing operation are complete. Examples include slash (tops and branches), sawdust, bark or shavings.

Heat Pump — A mechanical device which can extract heat from a lower temperature source of heat and upgrade it to a useful temperature. Since heat pumps move heat rather than create it, high overall efficiencies can be obtained.

Hog Fuel — Waste material from lumber production or pulp and paper processing operations. This type of fuel usually contains a high percentage of bark and is usually burned in large boilers like those in pulp and paper mills.

Marginal Cost — In the context of electricity, it is the cost to the utility of the next increment of capacity produced at any given time. For a utility with different kinds of generating capacity, the marginal cost will vary with total system demand because different types of generating capacity have different costs.

Merchantable Wood — Wood with commercial value under present harvesting practices in a particular area.

Peat — Fuel peat is decayed plant material located in swampy areas called bogs. To be usable as a fuel, it must be dewatered and processed into chunks of a uniform size.

Pulpwood — The stem wood of trees suitable for use as raw materials for pulp and paper operations. Spruce is a particularly desirable species for this purpose.

Roundwood — Wood used as firewood and fed to household or light industrial combustion equipment manually in large pieces.

Sawlogs — Stem wood suitable for manufacturing into lumber.

Silviculture — Forest management practices undertaken to maximize the growth of commercially desirable species of trees.

Wood Chips — Wood which has been mechanically sliced into small uniformly sized chunks. Clear pulp chips can be used for pulp. Chips containing twigs, bark, needles, etc., are normally used as fuel.

Wood Chip Harvestor — Machinery used to produce wood chips.

A detailed glossary of terms relating to specific aspects of forestry is available as part of the Nova Scotia Department of Lands and Forests 1983 "Submission to the Royal Commission on Forestry."